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TRANSACTIONS

OF THE

AMERICAN INSTITUTE

OF

ELECTRICAL ENGINEERS.

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26 CORTLANDT STREET, NEW YORK CITY.
Telephone, 2799 Cortlandt.

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

NEW YORK, March 25th, 1896.

The 104th meeting of the INSTITUTE was held this date at 12 West 31st Street, and was called to order by President Duncan at 8.15 P. M.

The Secretary read the following list of associate members elected and transferred at the meeting of Council in the afternoon.

Name.	Address.	Endorsed by
BETTS, PHILANDER 3d	Electrician, U. S. Navy Yard, Washington, D. C.	C. J. Field. Frank Bourne. O. G. Dodge.
BURGESS, CHAS. FRED'K.	Instructor in Electrical Engineering, University of Wisconsin, Madison, Wis.	D. C. Jackson. Wm. C. Burton. F. R. Jones.
CHAPMAN, A. WRIGHT	Electrical Engineer, Fort Wayne Electrical Corporation, Baltimore, Md.; residence, Brooklyn, N. Y.	Chas. S. Bradley. F. B. Crocker. M. I. Pupin.
FIRTH, WM. EDGAR	Chief Engineer, The Midvale Steel Co., Nicetown, Philadelphia; residence, 7203 Boyer St., Germantown, Pa.	Chas. B. Dudley. T. Carpenter Smith R. M. Hunter.
FORD, FRANK R. *M. E.*	Consulting Engineer, Ford and Bacon, 203 Broadway, New York City.	Jos. Wetzler. T. C. Martin. Wm. J. Hammer.
GIBBS, LUCIUS T.	Manager and Chief Engineer, Gibbs Electric Co., Milwaukee, Wis.	Maurice Coster. D. C. Jackson. H. J. Ryan.
GORRISSEN, CH.	Superintendent, Fort Wayne Electrical Corporation, Baltimore, Md.	Chas. S. Bradley. C. T. Hutchinson. F. J. Sprague.
GREEN, ELWIN CLINTON	Testing Department and Installing Work, Jenney Electric Motor Co. 206 South East St., Indianapolis, Ind.	Arthur Frantzen. H. H. Hornsby. C. C. Haskins.
HAMERSCHLAG, ARTHUR A.	Electrical Expert, and Owner, Hamerschlag & Co., 26 Liberty St., New York City.	O. P. Loomis. Jos. Wetzler. M. M. Mayer.

HULSE, WM. S.	Electrical Engineer, Fort Wayne Electrical Corporation, Baltimore, Md.	Chas S. Bradley. F. S. Hunting. W. M Stine.
LOZIER, ARTHUR DE LA M.	*M. E.* Salesman and Expert, Westinghouse, Church, Kerr & Co., 26 Cortlandt St.; residence, Hotel Winthrop, 125th Street, West, New York City.	E. J. Houston. A. E. Kennelly. R. T. Lozier.
MACKINTOSH, FRED'K.	Electrical Engineer, General Electric Co.; residence, 9 South Church St., Schenectady, N. Y.	A. L. Rohrer. H. G. Reist. W. L. R. Emmet.
MANSON, JAS. W.	Wire Chief, Franklin Street Exchange. Met. Tel. and Tel. Co.; residence, 80 York St., Jersey City, N. J.	J. J. Carty. H. Laws Webb. U. N. Bethell.
PHELPS, WM. J.	Electrical Engineer and Contractor, Chicago, Ill.	Alex Dow. Edw. Caldwell. Henry W. Blake.
PORTER, H. HOBART, JR.	Agent, Westinghouse Elec. & Mfg. Co., 120 Broadway, New York; residence, Lawrence, L. I.	C. T. Hutchinson. F. J Sprague. W. D. Weaver.
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SARGENT, HOWARD R.	Electrical Engineer, General Electric Co.; residence, 510 Union St., Schenectady, N. Y.	Chas. P. Steinmetz. John B. Blood. Wm. G. Ely, Jr.
STEWART, W M.	Wire Chief, Met. Tel. & Tel Co., 18 Cortlandt Street, New York City; residence, 80 York Street, Jersey City, N. J.	J. J. Carty. H. Laws Webb. U. N. Bethell.
THURBER, HOWARD F.	General Superintendent, Met. Tel. & Tel. Co., 18 Cortlandt Street, New York City; residence, 49 Sidney Place, Brooklyn, N. Y.	J. J. Carty. H. Laws Webb. U. N. Bethell.

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Approved by the Board of Examiners, Feb. 19th, 1896.

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BADT, FRANCIS B.	Electrical Engineer, Siemens and Halske Electric Co. of America, Chicago, Ill.
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BOYER, ELMER E.	Electrical Engineer, The General Electric Co., Lynn, Mass.

MITCHELL, JAMES,	Constructing Engineer and Agent, General Electric Co., Rio de Janeiro, Brazil.
COSTER, MAURICE,	Engineer, Westinghouse Electric and Mfg. Co., Chicago, Ill.
LLOYD, JOHN E.	Assistant Chief Engineer, Philadelphia Traction Co., Philadelphia, Pa.
POTTER, WM. B.	Engineer, Railway Dept. General Electric Co., Schenectady, N. Y.

The following paper was then read by Prof. Puffer, after which the meeting adjourned to Columbia University where the experiments were shown.

A paper presented at the 109th Meeting of the American Institute of Electrical Engineers, New York, March 25th, 1896. President Duncan in the Chair.

A NEW METHOD OF STUDYING THE LIGHT OF ALTERNATING ARC LAMPS.

BY WILLIAM L. PUFFER.

When a direct current of proper volume is caused to pass between the tips of suitable carbons, there is produced the phenomenon called the arc light. Generally the direction of the current flow is such that the upper carbon is the positive, and the lower the negative electrode. In order to produce a quiet and steady arc, the positive carbon may have a soft central core to aid in the formation of the crater from which the greater part of the light is emitted. The negative carbon may be cored or solid.

If we examine this arc light very carefully through dark glass, either smoked or colored, or better still, project an image of the arc on a white screen in a darkened room, using a good achromatic lens of large aperture and moderately long focus, we shall see pictured out a beautiful but inverted image of the arc in correct colors and intensities.

Knowing the direction of the current, we notice that the positive carbon has a very sharply defined crater of dazzling whiteness of about $\frac{1}{8}$ or $\frac{1}{4}$ the diameter of the carbon itself. From the crater the somewhat rounded point of the carbon diminishes in brightness, and finally verges into the dark unchanged carbon. Upon this heated carbon point the evidence of combustion is plainly seen in shape of changing surface and falling or accumulating ashes or scoriæ, while about it may be seen the flames of the burning carbon. The appearance of the negative carbon is quite different and clearly characteristic. The point is sharper, often with a little tip at the extreme end, while its base has a sort of crown or wall of ashes. The little tip is of whiteness equal

to that of the crater of the positive, but very small indeed. Below this tip is the hot pointed carbon which, however, is not nearly as hot as the positive.

In the space between the two carbons is the bluish violet light of the incandescent vapor in the path of the current. This is the arc itself, relatively non-luminous and in volume conical. The base of this blue cone is as large as, and is in contact with the crater, while the apex just touches the white tip of the negative carbon. Surrounding this core are several layers of gases of various shades of blue and yellow, and the flames of the burning carbons. The light thrown out by this combination of causes may be considered as coming from four sources. By far the greater part, from the white hot surface of the crater on the positive carbon, a much lesser amount from the little white tip of the negative; less than this from the carbons considered simply as two red hot sticks, and a very small amount from the hot gases. It is evident that a large part of the total light will be thrown downward.

Upon stopping the current, the heated carbons glow for some time; the positive is, however, very much hotter than the negative and keeps hot longer.

If, after the carbons have become cool, an alternating current is caused to pass between them, and sufficient time allowed for the points to become settled into their normal shape, it will be seen that the arc is naturally different in appearance from the direct current arc. Both carbons will be of the same shape, having rounded points, each with a small luminous crater, from which is emitted the greater part of the total light of the arc. Both carbons will show similar signs of combustion with the accompanying flames and ashes, and the light will be thrown upwards as well as downwards.

The blue arc between the two craters will appear as a band of nearly the same width in all parts, while about it are the several gaseous envelopes of different degrees of intensity. Upon shutting off the current, both carbons will be found of the same degree of luminosity and heat.

Somewhat more than a year ago, I wished to demonstrate to the senior class in electrical engineering during a lecture I gave them on alternating current phenomena, that, although when examined by means of a large projected image upon a white screen in a darkened room, the alternating current arc appeared to be

as steady as the direct current arc, and the light was thrown equally upwards as well as downwards, yet there were very great fluctuations in the light due to the intermittent heating of the carbon points.

The method chosen was the stroboscopic, which has given us at the Institute of Technology most excellent results in the hands of various experimenters while investigating the movement of transmitter electrodes, telephone diaphragms, tuning forks, vibrating strings, and the like.

A hand regulating arc lamp was placed in a lantern, with a large achromatic lens so adjusted as to make an image of the arc some ten feet long on the screen of the lecture room. A transfer switch and suitable rheostats were arranged so that either a direct current or an alternating current of about fifteen amperes could be used. At a convenient point a disk of about eighteen inches in diameter, in which were cut eight narrow radial slots, was placed so that the beam of light was interrupted as the disk revolved. The disk was fixed to the shaft of a direct current motor whose speed could be adjusted very closely by a rheostat in the armature circuit.

As the alternator used was a 125-cycle dynamo, and the disk had eight slots, the stroboscopic effect would be produced when the light of the arc would be allowed to pass at a frequency very slightly more or less than that of the dynamo, or $\frac{125 \times 60}{8} = 937\frac{1}{2}$ revolutions per minute of the motor armature.

Suppose, for example, it ran at 937 revolutions per minute, then, counting from the time when the current in the arc was zero, each receding flash of light would be $\frac{1}{250}$ part of a complete alternation behind the preceding one, and owing to the persistency of vision the arc would be seen on the screen, as if the alternations had been so reduced in speed that it took two seconds for a single alternation of the current.

An attentive watching of the image as the current alternates is now highly interesting and instructive, and can only be seen to be fully appreciated.

It is clearly shown that the alternating current arc is a sequence of direct current arcs, alternating in polarity, and that each wave of current produces very clearly and distinctly all the attributes of the direct current arc.

The hot positive carbon with its white hot crater, from which

extends the fan-shaped blue light of the arc to the small white tip of the colder negative carbon, will be seen to die away, and all light goes out except the glow of the red-hot carbons, and then light appears again with the current reversed.

Early in November last the subject was again taken up, with the very efficient aid of Mr. R. R. Lawrence, a post-graduate student in electrical engineering at the Massachusetts Institute of Technology, and rapidly developed with such beautiful results that it was decided to exhibit publicly before the the Society of Arts, which was done some little while after, at the regular meeting of January 2d, 1896.

We first attempted to take a set of instantaneous photographs of the arc at different periods of an alternation, and by the use of a pneumatic shutter, and a progressive motion of the lens, obtained some very sharply defined pictures. After many trials, this was given up, because of the practical impossibility of timing the exposures with respect to the alternations, and we decided to use a disk with half as many slots as there were pole-pieces on the dynamo, and to drive it by the shaft of the machine itself.

The dynamo available was one giving a three-phase 500-volt current with a frequency of about 60 cycles. Two wires only were used to give us the current required.

A somewhat long, light shaft, carrying at one end the disk, and at the other a positive mechanical clutch, was mounted in line with the armature shaft. As the clutch could only be thrown in when the two shafts were nearly equal in speed, a small motor was placed so as to bring the disk up to speed when the clutch was thrown in and the motor belt removed.

The disk was held in place by a frictional clamp disk on the shaft. A graduation and reference mark served to measure angular change of disk on shaft, and therefore of slots with reference to the pole-pieces or alternation of the current.

The arc to be tested was put in a boxing to keep away air from the currents close behind the disk, and a camera with a roll holder in front of the disk. With this arrangement the arc as seen was perfectly steady at any part of the wave that corresponded to the position of the disk on the shaft, and as the process of stopping, setting and starting the disk was very rapid, the roll holder being in the meantime turned, many pictures could be taken in a very few minutes.

Generally it was not necessary to take more than twelve exposures in order to get a series showing clearly the changes in light intensities during a single phase.

We found that it was about as instructive to watch the appearance of the arc on the ground glass of the camera, and far more beautiful. In this way we examined both the effect produced in the arc by change in the voltage of the circuit, the current being kept constant by alteration of the resistance.

For example, with 500 volts, and a large non-inductive resistance in series with the arc, it was plainly evident that the current wave was approximately sinusoidal, as the time of extinction of the current, as indicated by the blue band of the arc proper, was very short, and the rise and fall of the current gradual and with no irregularities. This is to be expected, as the back E. M. F. of the arc is small compared to the voltage of the generator, and the circuit as a whole is non-inductive.

The opposite condition was realized by using a lower E. M. F. and regulating by a reactive coil. The time of no current was longer, and the current appeared to jump to its maximum in an exceedingly small angular time. In this case the arc was not steady, showing clearly to the eye that the succeeding waves of current were not alike either in form or current value, and also that the angle of lag was constantly changing. This fact has always prevented an accurate plotting of wave forms by the instantaneous contact method, and although known to exist, was never before actually seen.

A very pretty double arc was arranged by using three carbons and wiring two circuits, each with current regulators, in such a way that the arc was the common junction, and one carbon was of one polarity, while the other two were of opposite polarity. With wire resistances in each side, there was nothing peculiar to be noted other than the effects of the junction of two currents, but when the resistance in one circuit was gradually cut out, and equivalent inductance cut in, there was at once visible evidence of the lag of the current, together with the change of shape of the wave and the unsteadiness before noted. Owing to the long time of no current in the inductive side there were times when even with considerable lag there were actually no visible traces of current between either points. This effect was dependent on adjustment of current strength and inductance, as well as voltage. The sequence of currents and polarity in this arc was most beauti-

fully brought out when the disk was disengaged from the shaft, and driven by the little motor at a rate very slightly less than the dynamo.

We found that work in the immediate vicinity of the dynamo was not very desirable, owing to air currents and excessive vibration, so we arranged a combination of motors that will produce at any distance from the dynamo all the desired results.

A very nicely balanced brass disk with four radial slots in it was attached to the armature shaft of a Holtzer-Cabot synchronous induction motor of eight poles. The pulley of this motor could be driven by a light belt from a self-starting induction motor of the same make, which is, however, not quite synchronous under load. By trial the two pulleys are wound with rubber tape until their ratio is such that the brass disk will be uniformly driven at a speed a trifle above synchronism, and the arc light can be seen through the slots to pass through the alternation at a desirable rate.

By a single movement of a switch, the non-synchronous motor is cut out, and the synchronous cut into circuit when the armature drops into step with the dynamo, and the arc is instantly seen as fixed, the belt is thrown off or left on, as desired. These armatures may be on the same shaft, if necessary. The synchronous motor does not stand on its base, but rests on the turned outside of its bearings in pillow blocks which are attached to a suitable base frame.

Concentric with the shaft and firmly attached to the motor is a brass gear, six inches in diameter, and on it a graduated circle. On a lever pivoted so as to be thrown to or from the motor gear is a small spur gear with a milled head for turning.

Turning this head will evidently cause the motor to slowly rotate about its axle, and as the armature must be in step with the dynamo, and as the turning of the motor changes the position of a given pole-piece relatively to the arc light, it follows that any part of the alternation of current in the arc may be seen on the screen, and as the motor has eight poles, a quarter turn or 90° on the graduated circle corresponds to a complete cycle in the arc.

The picture of the arc can then be photographed, measured, or in any way studied at leisure in any phase relation, as, for example, when the top carbon is positive, or when there is no arc at all and only dull red carbon points visible.

In this way we have seen single arcs of high and low E. M. F., long and short double arcs, arcs with much inductance in circuit, Jablochkoff candles, arc between a ring and a point within, the spinning arc between the ends of a carbon cylinder and a concentric carbon within, with a magnetizing coil around the inner carbon and the like.

One of the most beautiful arcs investigated by us visually and

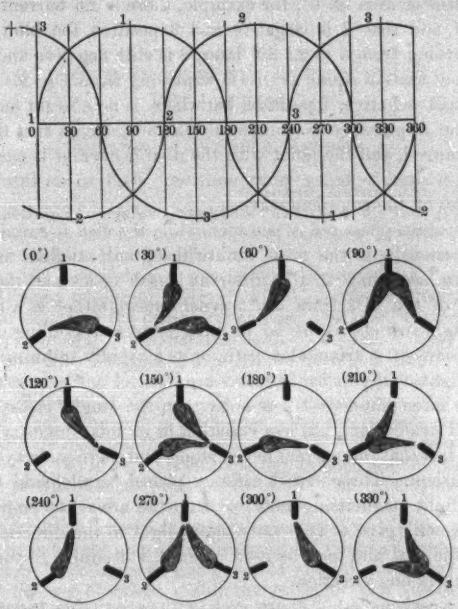

FIG. 1.

photographically was a rotary arc made by the use of three carbons in the same plane, at angles of 120° apart and wired up as the junction point of an external Y load on a 500-volt 60 cycle three-phase generator. Non-inductive resistance was used in the circuit, and the current used in one leg of the Y was 10 or 15 amperes.

Twelve photographs were taken at equal intervals of 30° in an alternation of the current in one wire. Fig. 1 shows very

clearly the relation of the current waves from the different carbon points, and the curved, fan-shaped figure indicates the position and direction of the bluish arc at the corresponding angle. The base of the fan rests on a positive carbon which has a white-hot crater and all the appearance of the positive carbon of a direct current arc, while the tip of the fan rests on the white spot at the end of a negative carbon.

It will be seen at 0°, for example, there is no current on carbon 1, and that 2 is negative and 3 positive, the blue fan-like arc curving from 3 to 2: 30° later, 2 is still negative and 3 positive, but that an equal arc is now playing from 1 to 2. At 60° 2 is still negative, 1 positive, but there is no current on 3. At 90° the appearance is somewhat like 30°, except that the signs are changed, and the point with the double current is necessarily much whiter, it being now positive. And so on through the changes of the complete wave.

This three-phase arc, when seen while the disk is running non-synchronously, is the most beautiful of any studied, and may be seen according to the different length of arc and the divergence of the disk from exact synchronism, either as a band of blue light which seems to be progressively travelling over the three sides of a triangular path, or as a rapidly spinning star of blue light, being in fact a rotary arc.

The three-phase arc is less noisy than the single phase, and its light is steadier and has less variation in its total intensity, owing to the fact that the current never stops, and there is always a positive carbon. Three cored carbons, placed parallel side by side, with slight magnetizing coils to keep the arc at the ends of the carbon, will give a very satisfactory light in the direction away from the tips, and may be used when it is desirable to throw the light all in one direction.

Four carbons at 90° apart, each with a suitable resistance in series with it, and connected to quarter-phase tap wires on a Gramme ring or other generator giving quarter-phase circuits, will also produce a rotary field arc of great beauty and interest.

Study of these arcs is still going on at the Institute of Technology under my immediate charge, which will, I hope, produce results sufficiently interesting to justify a second paper at some later date.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Meeting of Western Members.

Chicago, March 25th, 1896.

A meeting of western members was held at the Armour Institute, this date for the purpose of exchanging information in regard to the "Röntgen Ray."

About 250 members and guests were present, Vice President A. S. Hibbard presiding. Mr. Charles E. Scribner presented a historical sketch of the discovery, and also described experiments made by him and the apparatus used. Dr. James Burry also spoke on "The Surgical Value of the Röntgen Ray." Prof. Stine presented the following details of his experiments.

Prof. Wilbur M. Stine:—In the original paper by Prof. Röntgen the statement is made that when the cathode stream is deflected by a magnet, the X ray is given off from the new point of impact on the glass. By implication, it then seemed that the ray was produced at all points of the wall of the tube upon which the charged molecules constituting the cathode stream, impinged. This information proved too vague to materially assist the experimenter in investigations or in the design of Crooke's tubes. The fact that Geissler tubes do not generate the ray, indicated either that the ray was absorbed within the tubes, or that the cathode-repelled molecules lost their charge before reaching the walls of the tube. Again, were there two sources of the rays,—the surface of the cathode or some of the charged molecules of the stream, and the glass of the tube? Some time since, the writer showed that the fluorescence of the glass did not of itself, even when associated with a static charge, produce the ray. This pointed out the criterion for the successful tube, that it was one in which the vacuum was sufficiently high to permit a free molecular path from the cathode to the glass of the bulb.

Further, it has been recently stated on the best of authority that sciagraphs are produced not by the cathode, but are *anodic*. From the very first, the writer has kept these considerations in

view, and endeavored to obtain definite facts which should, beyond doubt, establish the source and distribution of the ray. In the following description the historical sequence will be preserved and a few leading dates indicated.

From the very first, penumbral effects were observed. The first accurate experiment was made about February 20. A rod of iron was separated a fixed distance from the plate, the distance of the plate from the end of the bulb being already noted. The penumbral effects were plotted back and showed that the rays were emitted from almost the entire end of the tube. This experiment was repeated and varied a great number of times with about the same results. Early in the present month a more exact result was obtained. Pieces of flat brass about $\frac{3}{4}$ inch in width were soldered together to form a geometrical figure. As these

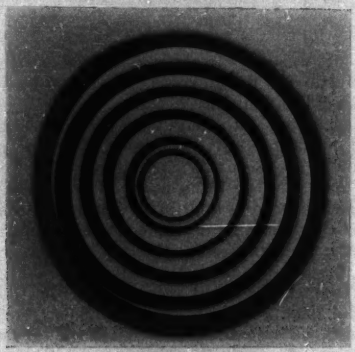

FIG. 1.

rested edgewise on the plate, the width of the shadows could be measured with great accuracy. These, when plotted back to the tube, indicated a source of the rays circular in shape and about $1\frac{1}{2}$ inches in diameter, this area corresponding in size and position with the dark ring, (the cathode imprint) on the bulb. Was this then, *one* or the *only* source of the ray? It then occured to the writer, that a short tube would indicate very clearly the space distribution of the rays. Accordingly, sections $\frac{1}{2}$ inch in height were cut from brass tubing, No. 18 gauge, of diameters ranging from one-half to three inches. These were placed concentrically on a dry plate, and a sciagraph taken with the rings parallel with the end of the bulb and at a fixed distance from it. The tube in this case was a small pear-shaped one. The shadows were concentric, and, plotted back to the tube, indicated that a circular

area about 1½ inches in diameter was the prime source of the X ray (Fig. 1). To test whether the flat anode was also active, similar rings were placed opposite it. In this case, the shadows, instead of being concentric, were elliptical, and plotted back to the former area[1] (Fig. 2).[2]

Amongst the first experiments was one to test whether the ray could be polarized. It was found that tourmaline plates were sufficiently transparent. Two exposures were made, one in position of maximum transmission, the other at 90°, or in the crossed position. In both cases, with equal exposures, the tourmalines were equally transparent.

Another interesting experiment was to determine whether

FIG. 2.

various grades of dry plates were more or less sensitive to the Röntgen ray. The results showed that the time of exposure was not influenced by the light-speed of the plates. Slow plates have since been exclusively employed, since they work with greater density and clearer shadows. The writer had the pleasure of being the first in this country to announce this important discovery.

This experiment possesses much theoretical interest. Röntgen and others have stated that the effect of this ray on silver salts was probably due to fluorescence which it induced on the film.

1. Shortly subsequent experiments made by the writer, employing the same method, clearly indicate that there is also a more or less weak secondary source, viz., wherever the cathode particles impinge upon the walls of the tube.

2. The letter "A" here designates towards bulb *opposite* the *cathode*.

Were this the case plates exposed to such rays would act in proportion to their light speed, since fluorescent light is highly actinic.

Much stress has also been placed on fluorescent glass bulbs as the source of the ray. To test this, a cube of uranium glass was powerfully excited by a focused arc light, but only negative results were obtained in repeated and lengthy exposures. The surface of the cube was also kept charged by a Holtz machine, but no results were obtained. The fluorescence of the bulb of the Crooke's tube seems rather an accidental than a causative phenomenon. The kinematics of the Röntgen ray was carefully and exhaustively studied. In short, no evidences were found of diffraction, refraction, reflection or interference. There are many appearances of such character, which have evidently misled some rather untrained experimenters, yet when carefully studied are found of negative value.

The writer's experiments have been extensive, and have been so fully described in the columns of the current technical papers that their repetition here seems unnecessary. Only a few of the more important results have been noted above.

Upon motion of Mr. B. J. Arnold a vote of thanks was extended to Mr. Scribner, Dr. Burry and Prof. Stine for their contributions upon the subject of the evening and the meeting adjourned.

Applications for Membership.

Applications have been received from the following candidates and will be acted upon by Council at its next meeting:

F. D. Sampson, Charlotte, N. C.	John Peter Labouisse, New Orleans, La
Alexander C. Rideout, Hillsdale, Mich.	N. W. Huggins, Seattle, Wash.
James G. Biddle, Philadelphia.	Eugene Maxwell, Seattle, Wash.
John Falconer Van Vleck, N. Y. City.	Heiichire Maki, Kioto, Japan.
Eleazer Darrow, Cincinnati, O.	Joseph D. Hathaway, Jr., N. Y. City.
Carl Hugo Satherberg, Philadelphia.	Julian H. Granbery, N. Y. City.
I. Brayshaw, Buenos Aires.	Thomas V. Bolan, Schenectady, N. Y.
Arthur E. Appleyard, Natick, Mass.	J. P. Hall, New York City.

Should a member object to the election of any of the above candidates, he should notify the Secretary to that effect prior to July 22.

RALPH W. POPE,
Secretary.

26 Cortlandt Street,
New York, June 24th, 1896.

DIED.

PECK:—En route from Mexico to Boston, June 13th, 1896, Samuel C. Peck, formerly of Boston. Mr. Peck was born in Newtown, Conn., April, 1866, and was elected an associate member of the INSTITUTE September 6th, 1887, at which time he was electrician for the Simplex Electrical Co., at Newtonville, Mass. He subsequently entered the employ of the Thomson-Houston Electric Co., at Boston. In 1890 he went to Mexico, where he has been since continuously engaged as agent of the General Electric Co. He started North for the purpose of having a surgical operation performed and died on the train about three hours ride from the City of Mexico.

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After printing the monthly, the papers and discussions are revised, repaged, and the sheets for the annual volume printed from the corrected type, and laid aside till the close of the year. As the index is made for the volume and not for the monthly parts, the complete volume sent at the end of the year becomes the permanent record. Upon its receipt the monthly parts are superfluous. They may be returned to this office at our expense, as there is a continual demand for separate copies of papers.

RALPH W. POPE, Secretary.

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Mailed separately, price 10 cents.

RALPH W. POPE, Secretary,
26 Cortlandt Street,
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